AECOM

Saint Paul Regional Water Services

November 6, 2015

Proposal for Engineering Services

Raw Water Conduit Assessment

4 Project Approach

Introduction

SPRWS is relied upon to provide drinking water to nearly 415,000 customers in the City of St. Paul and neighboring communities averaging 45 million gallons per day (MGD) of use. The major source of this drinking water is the Mississippi River at the Fridley intake facility with a capacity of 90 MGD. From there, the raw water is conveyed approximately 8 miles to a chain of lakes via two parallel 60" conduits (Mississippi Conduits). The source water flows through the chain of lakes, canal system, and another two parallel 60" conduits (Pleasant Lake Conduits) via gravity ending up in two parallel 90" conduits (Vadnais Lake Conduits) that convey the water approximately 4.4 miles to the McCarrons Treatment Plant.

The following are basic components of the raw water supply system:

- Mississippi Conduits (Twin 60") – Conduit #1 constructed in 1924 of 1.6 miles riveted plate steel and 6.3 miles of cast-in-place reinforced concrete (CIPC); approximately 500 feet of steel portion replaced with prestressed concrete cylinder pipe (PCCP) in 1989. Conduit #2 constructed in 1958 is all steel.
- Pleasant Lake Conduits (Twin 60") – Conduit #1 constructed in 1936 of 0.5 miles CIPC. Conduit #2 constructed in 1957 is all steel.
- Vadnais Lake Conduits (Twin 90") – Conduit #1 constructed in 1925 of 4.4 miles CIPC; approximately 0.5 miles near the treatment plant abandoned, bulkheaded, and diverted to Conduit #2 in 1989. Conduit #2 constructed in 1960 is all steel; approximately 0.5 miles (same stretch as Conduit #1) diverted to new steel conduit running parallel to new Conduit #1 in 1989.

All steel lines noted above are coated and lined but were not equipped with active corrosion protection systems such as cathodic protection.

The lines have some unique operational features and issues which are driving the need for assessment and will shape the overall program. These include:

- The supply lines, outside of peak demand season are redundant, such that dewatering and removing one of the lines at a time from service is entirely feasible.
- The supply lines are in low head service with a small rise in the HGL in the Mississippi Conduits to get over a small bump in the profile and then often transition to open channel flow.
- The supply lines have pressure manholes at reasonably regular intervals for access. Access size is close to current standard manhole access points.
- Mississippi Conduits and Vadnais Lake Conduits lie in pretty decent corridors that would facilitate access for inspection and repair.
- Mississippi Conduit #1, to date has had the most significant operational history. This has been primarily associated with the CIPC pipe, which has had numerous joint leaks. To date, repairs have been undertaken with conventional joint seals (i.e. WEKO-SEAL style of repair) which appeared to work initially but have resulted in some leaks re-surfacing over time.
- No leakage testing has been carried out on any of the lines and the need for repair to date has largely been identified by water rising to the surface.
- Aside from visual observations of the CIPC pipe during past repair programs, no rigorous physical condition assessment has been carried out.

The primary objectives of the overall program are to:

- Develop a clear understanding of the current condition of the pipelines, the nature and severity of defects and spatial distribution along the length of the pipe.
- Identify factors that led to the defects occurring and future deterioration risks for the supply lines in their present state with current operation and maintenance protocols in place.
- Develop an assessment of the effectiveness of past and current repair methodologies and anticipated design life.
- In conjunction with SPRWS, establish performance/service criteria as a benchmark to quantify acceptable condition and service level objectives moving forward.
- Assess residual life and anticipated service level degradation without intervention, and
- Develop an optimized rehabilitation program to meet the defined performance and service objectives.
- Quantify the certainty of the program assessment based on the level of field activities undertaken.
- Develop a prioritization plan for distribution system elements comprised of PCCP investigating risk of failure.
- Develop comprehensive mitigation plan prioritizing inspection, maintenance, and capital requirements.

Our approach will build upon the best practices and hands-on experience from across North America and abroad, to establish risk-based planning and decision making criteria for SPRWS Raw Water Conduit Assessment.

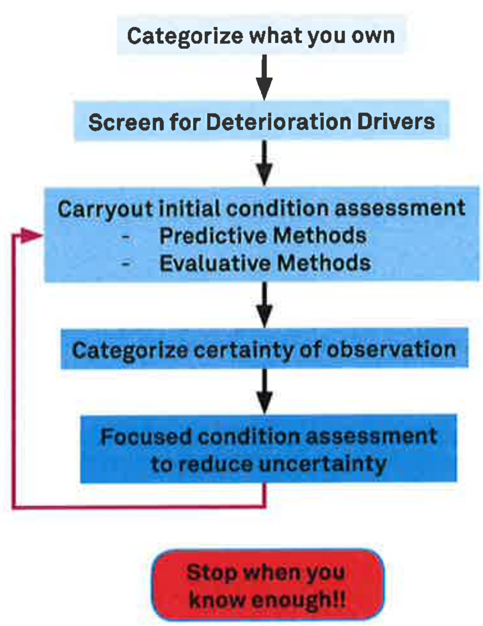
The benefits of AECOM's approach will provide a clear direction for annual repair and inspection costs based on risk based prioritization techniques. This approach will integrate consequence ratings with the condition assessment strategy, assign condition ratings and confidence factors reflecting the probability of failure over a time horizon, and develop decision criteria to prioritize inspection requirements, maintenance and capital requirements into a comprehensive mitigation plan.

Task 1 – Kick-off Meeting and Background Data Collection

AECOM will work with the SPRWS team to create an organized summary of available data pertinent to the project. Data will include but is not limited to asbuilt drawings, historic and original construction photos, maintenance and repair history of the pipes, reports, GIS data, and verbal information from SPRWS staff.

AECOM will organize and conduct a project kick-off meeting between SPRWS and our team's technical leaders. The kick-off meeting will:

- Establish client expectations and goals for the project.
- Reconfirm the project work scope and AECOM's project team.
- Review and confirm the project schedule.
- Confirm data provided to AECOM by SPRWS and discuss any additional data needed to perform the project.
- Kick-off work on all of the tasks of the overall project, describing the planned approach for executing each task.
- Identify communication protocols.
- Identify key issues and critical success factors.



Task 2 – Desktop Analysis

Once all pertinent data is collected and organized, AECOM will incorporate all variables into a GIS data schema that can be used as a base map for the desktop analysis and will be easily incorporated into SPRWS' existing GIS system. Overall risk based approaches for condition assessment have long been recognized as the most coherent approach to relate rehabilitation and/or intervention policy to knowledge of condition and the consequences of failure. A traditional policy driver matrix is depicted in Figure 1 to the right.

Risk = Probability of Failure x Failure Consequence

Utilizing risk based approaches in this manner provides clear direction for the overall condition assessment process in terms of balancing priorities and assisting in the clarification of what level of investment is prudent to be made with each specific segment of the raw water conduits. This approach is very similar to the work completed for SPRWS and the Water Main Prioritization project. Another Risk Based Condition Assessment screening completed by members of our team was for the Tampa Bay Water (TBW) utility for PCCP prioritization depicted in Figure 2.

Figure 1

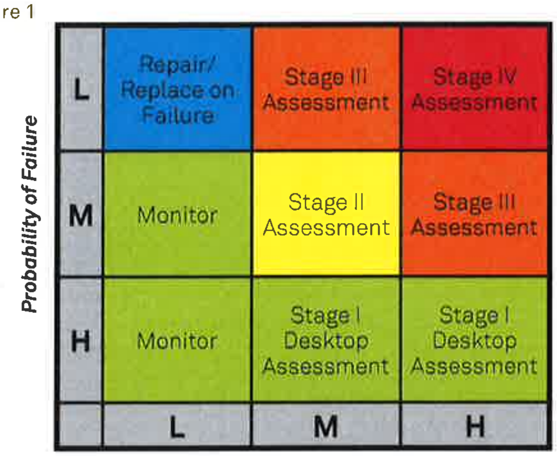
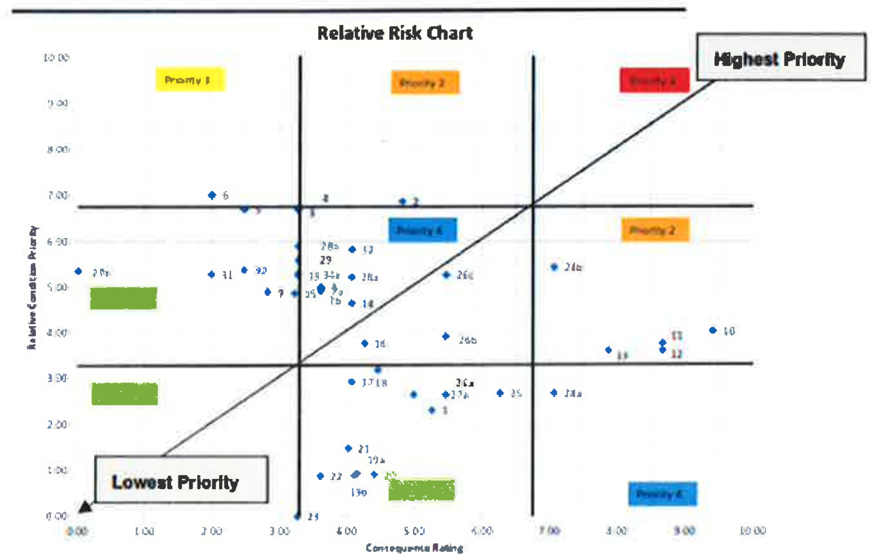


Figure 2: Tampa Bay Water (TBW) Relative Risk Chart



Using the existing City's GIS inventory as a base, AECOM will work with SPRWS staff to develop a criticality model assessing the relative consequence of failure for segments of the raw water conduits. All readily available attribute data to define the physical characteristics of the segments (e.g. size, material, age, depth, repair history, etc.) will be compiled in conjunction with other available datasets to produce a criticality model. The consequence model for SPRWS twin raw water supply conduits differs from a consequence analysis for a distribution system. A distribution system has many level-of-service variables such as critical end users, size of users, fire services, water quality, water quantity, etc. The raw water conduits will not have the same level-of-service variable, but will share similar components to the distribution system consequence model such as: land use, size, material, river crossings, road crossings, environmental issues, flow, redundancy, etc. AECOM will work with the SPRWS team to develop the method for quantifying the consequence and probability of segment failure.

AECOM will complete a soils analysis and incorporate into the risk assessment to determine segments of the raw water conduits that may be subject to corrosive soils. Figures 3 and 4 show the potentially corrosive environments based on USDA data for both cementitious and ferrous metal degradation respectively.

AECOM will overlay all variables from the desktop analysis in GIS and provide a visual analysis highlighting segments of the conduits showing multiple levels of risk potential. A cluster analysis will also be performed which will screen areas with previous repairs overlaid on the risk potential and prioritize any identified clusters for additional inspection or repair.

Task 3 – Joint Testing/Internal Inspection

SPRWS has identified that the primary concern in the pipelines is leakage at cast-in-place concrete pipe joints. The era of construction of these conduits predates use of modern gasketed bell and spigot joints. The joint detail relies on a crimped copper waterstop as depicted in Figure 5. While this style of joint was a commonplace and effective joint style at the time, the copper waterstop has a propensity to fail over time, resulting in a hairline fracture which facilitates leakage. This leakage can result in degradation of soil structural properties external to the pipe, potential erosion of soil resulting in voids, and nuisance surface water. While the general hydraulic gradient under operation will be to the exterior of the pipe, it is also possible for certain contaminants to move through the pipe joints by diffusion. External soil groundwater can also contribute to cyclical wetting and drying of the soil structure, which can aide in migration and concentration of chemicals at the surface of the pipe such as soil sulfates and chlorides. Sulfates can result in degradation of the cement matrix in the pipe wall, or growth of ettringite crystals within the cement matrix, resulting in "onion skinning" delamination's in the pipe wall. Chloride penetration into the pipe wall, over time, will result in loss of the protective high pH properties of portland cement, and result in corrosion of the steel reinforcing. Eliminating or reducing joint leakage is of paramount importance in extending service life of the structures.

Figure 3: Potential for Cementitious Degradation Based on USDA Data

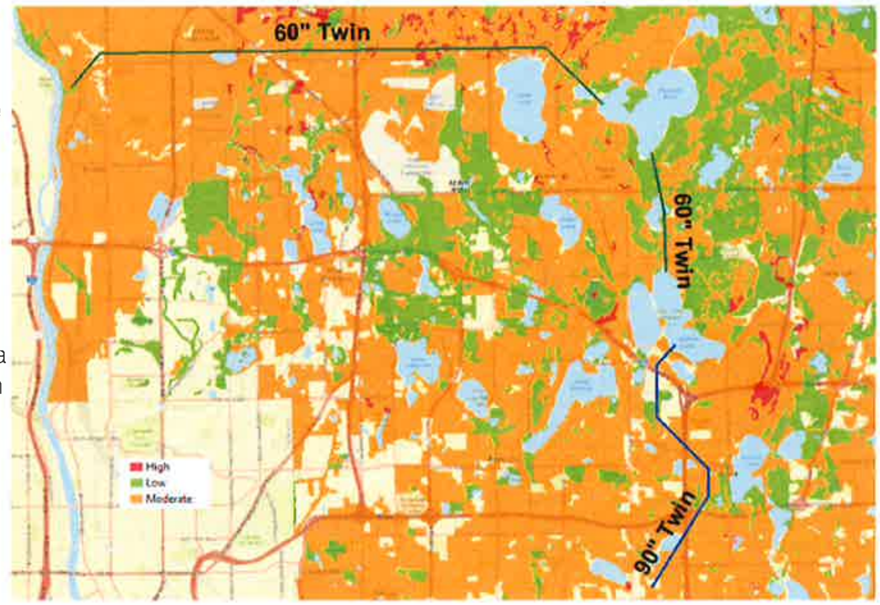
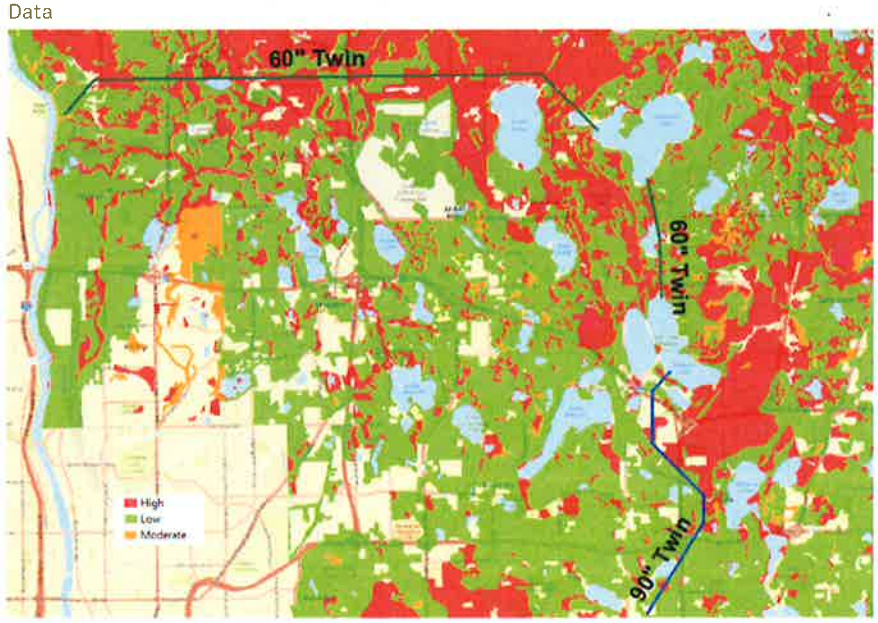


Figure 4: Potential for Ferrous Metal Degradation Based on USDA Data



As these conduits operate in a low head gravity driven hydraulic regime, many of the modern "leak listening" technologies cannot be used to identify the location and severity of leakage. Visual internal inspection can identify leakage when the external groundwater is elevated above points of leakage, but cannot reliably identify all leaks. Use of a joint testing device is often effective at identifying leakage. This technology is usually utilized in the waste water field, however has been effectively used in similar low head water applications. AECOM has successfully implemented joint testing programs on the Shoal Lake Aqueduct in Winnipeg, Manitoba Canada on several thousand 96 inch cast-in-place pipe joints and 66" precast pipe joints with a similar crimped water stop detail. Procedures outlined in ASTM C1103 are recommended with modified to form basis of a joint testing program.

For the SPRWS project, the 6.3 miles of CIPC Mississippi Conduit contains over 1,600 joints at 20' spacing, the approximate 0.5 mile of Pleasant Lake Conduit contains over 130 joints and the 4.4 miles on Vadnais Lake Conduit would contain over 580 joints at 40' spacing. To effectively test all joints in the system by use of a joint tester may be cost prohibitive, and may have some inherent risks in a full scale deployment without knowledge of the effectiveness of the program and potential concerns with deployment. As an example, if the pipeline concrete is porous or contains honeycomb "false positive" leak results can occur as the test medium circumvents the testing frame seal bladders.

AECOM recommends a trial program for joint testing, utilizing Miller Pipeline, a subcontractor experienced in this type of testing and apparatus. If the program proves successful, it could be extended to fully test the pipeline, using external forces, or possibly internal forces trained during the trial program. This latter approach has proved quite successful in our Winnipeg experience saving over $10 million in their previous repair approach, as municipal forces can engage in a continual monitoring program, over time. A onetime test program provides an excellent snapshot of the system, however, continued fatiguing of water stops will occur over time and need to be identified and addressed.

AECOM has allowed its proposal for a 5 day trial program of joint testing. The testing program includes purchase of a 60" and 90" Cherne AirLok joint testers which can remain with SPRWS for use in future programs or for ongoing testing with their own forces. Miller Pipeline qualifications and the quotation for the pilot test and equipment purchase are shown in Appendix A.

A second area of potential leakage in cast in place pipe is leakage at the construction joint as identified in Figure 6. This detail is present in both the 60" and 90" pipelines. There does not appear to be an active waterstop in the detail, or it was omitted. A pour joint such as this is a prime area to develop cold joints and honeycombing, and can often be a source of leakage. Isolating this joint for testing is difficult, although there are excellent repair strategies to repair leakage in these areas, such as polyurethane injection.

Figure 5

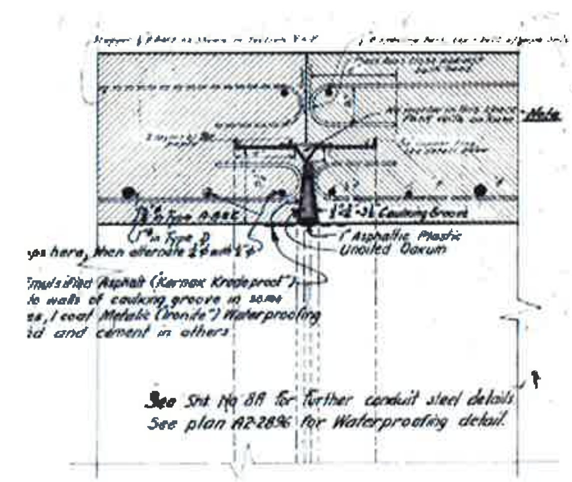
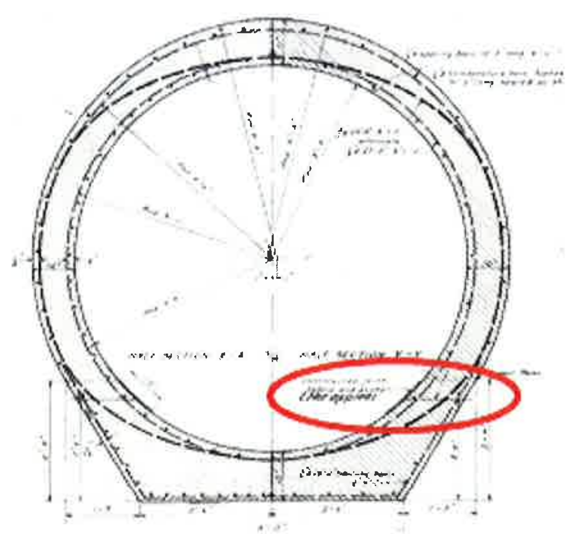


Figure 6



It is also understood that SPRWS implemented a program of sealing joints through use of an internal compression seal called the WEKO seal. AECOM has significant experience in the installation of several hundred WEKO seals in both cast-in-place pipe and precast pipe, similar to the designs used in this project, with a 100% efficiency in repair of pipe joints to pressures as high as 55' static head. AECOM and Miller Pipeline propose to inspect a sample of these installations to determine if the seals are functioning as intended and to possibly troubleshoot installation concerns.

AECOM will provide visual assessments with a four-man operation; two AECOM staff in addition to two staff provided by Professional Engineering Services, Ltd. (PES), a certified DBE in the state of Minnesota. The field assessments will be comprised of two staff in the pipe and two staff of surface support. All field staff will be confined space entry trained per OSHA guidelines. PES qualifications are shown in Appendix A.

The visual assessments in addition to piloting joint testing will provide a full understanding of the Raw Water Conduit system to provide a complete

Added value that may benefit SPRWS on internal inspection task is a multi-sensor assessment tool. Implementing this analysis for the Raw Water Conduit Assessment without first assessing the pipe and primary driver defects would be far too costly to recommend.

However, AECOM has found from its inspection experience in other Winnipeg programs that if the correct platform is chosen it can be a very cost effective tool versus man entry inspections.

In a Winnipeg pilot program, the cost of multi-sensor technology with all sensors deployed was $17/foot of pipe. The all-in cost of planning, support and assessment including the multi-sensor costs was $23/foot of inspection and assessment due to the magnitude of data collected.

By targeting the platform to the specific driver defects of concern and managing risk effectively the final cost of all assessment to date (including the pilot program costs) has been $8.50 per lineal foot (versus an all-in sensor cost of $23/foot). The cost of securing the data reduced to about $6.70/foot or less than half of the original estimate and the assessment and support costs were reduced to about $2.10 per foot or one-third of the originally project costs. These reductions were achieved through automated processes, extraordinary advances made in data management, effective project management and excellent judgement in risk distribution (so that contractor's did not have to bore unreasonable risks) and in risk management (e.g. by effectively making sure that nothing went wrong).

AECOM proposes to subcontract SewerVue to complete these services to the extent deemed necessary from initial visual screening and pilot testing of the joint testing. SewerVue qualifications are shown in Appendix A.

For the steel pipe utilized in this utility, a catastrophic pressure failure is unlikely due to the low head nature of the pipeline. Pinhole corrosion and pitting will eventually result in leakage through the pipe wall.

Long term advancement of corrosion could compromise structural integrity of the pipe through degradation of the pipe-soil envelope as leakage occurs. As sections of this pipe are in conditions that may include high external soil and live loading, and potential external elevated groundwater, pipe performance limits such as buckling could be of concern. Ideally, a thorough inspection via magnetic inspection technologies such as remote field technology (RFT) would provide a complete indication of overall wall loss; cost of an extensive program would be cost prohibitive. While RFT inspection of steel pipe sections would be a valuable assessment tool, targeting of potentially vulnerable sections after an initial screening would likely result in a better cost-benefit relationship.

A general initial assessment of the pipeline condition would aide in identification of areas of concern. AECOM proposes to conduct a visual inspection of the entire steel pipe sections. We would also propose to target a sample of pipe conditions based on pipe type and external environment and conduct representative non-destructive testing through use of a gridded ultrasonic pipe thickness (UT) survey. Target areas would also undergo a thorough internal corrosion pit survey. The internal corrosion pit survey would provide a measure of internal corrosion, and when measured in conjunction with a UT wall thickness survey, would also provide insight into the external, and generally more aggressive, external pipe environment and condition. If coordinated with a targeted external program, a comprehensive representative condition assessment could be determined.

AECOM proposes to conduct up to 5 complete UT and pitting surveys on representative pipe samples. Each representative site would include a 10 foot pipe segment and complete circumferential grid.

Task 4 – External Assessment

External excavations and pipe inspections will be conducted at up to 20 locations. It is understood that SPRWD resources will complete the excavations, including obtaining all permits, traffic control, securing and shoring the excavations and all backfill and restoration.

The locations for excavations will be selected, based on a review of expected pipe environments, a selection of pipe type and vintage, and expected defect locations based on the internal inspections. Locating excavations opposite internal inspections would have advantage of providing a complete understanding of the installation, inside to out.

Due to the overall project schedule, it is likely that excavations may need be advanced when the pipelines are in service. It will be of paramount importance to establish a safe excavation protocol to ensure that damage does not result to the pipe, resulting in potential leaks or failure. Development of a protocol could include procedures such as;

- Accurately locating the pipeline
- Advancing the excavations equally on both sides of the pipe to prevent potential differential soil loading on the pipe
- Use of non-aggressive excavation tools such as smooth edged trenching buckets to minimise potential spot impact damage
- Use of "soft" excavation techniques in close proximity to the pipe, such as hydroexcavation and hand excavation to minimize occurrence of damage to the pipe.

The terms of reference discuss excavations to inspect condition of foundation piles. While there is merit in this activity to assess condition, it would be obvious that this would be a high risk activity, that should only be undertaken with judicious planning and consideration of the benefits.

For each excavation, AECOM would be present to ;

- Log soils information within the pipe zone and collect representative samples of soil and/ groundwater
- Measure in-situ soil bearing pressures with soil vane or penetrometer
- Visually inspect the pipe surfaces and note defects
- Visually inspect pile cap, if present
- For concrete pipe, mark location of reinforcing steel and secure partial depth concrete core
- Repair core hole with non-shrink grout
- For steel pipe, secure thickness measurements with UT tool
- Measure pipe soil potentials

Soil and groundwater samples would be analyzed for sulfates, chlorides and an electrochemical provide including soil resistivity.

Concrete samples would be visually inspected and undergo laboratory testing to determine density, air void ratio and compressive strength. Selected samples may be subjected petrographic analysis.

AECOM has allowed for 8 hours of on site inspection time per excavation. AECOM time will be limited to soil sampling as excavation proceeds, inspection of the pipelines, photographic record. It is noted in the RFP that AECOM services for preparation of the site, traffic services, utility locates, permits are not required. It is also assumed that services will not be required for backfill and restoration of the excavation, and any required engineering for shoring or advancement of excavations would not be in scope of this RFP.

Task 5 – Final Report/Maintenance Plan

A draft report and maintenance plan, consolidating findings and work product from each task will be developed and submitted for SPRWS's review. In addition to summarizing project outcomes the document will provide a way-forward strategy for the condition assessment process supporting the sustainable management of the City's critical raw water conduit segments. Stakeholder feedback will be collected and discussed at a workshop session with SPRWS staff and incorporated into a Final Report.

The Final Report will include:

- Organization and interpretation of internal and external inspection data completed to-date, sample results, and engineering analysis on pipeline condition assessment
- Descriptions and maps identifying locations of segments with high risk of failure
- Descriptions and maps identifying complete conduit system and prioritization rankings for all segments of pipe
- Final probability and consequence of failure model components used for determination of risk.
- Recommendations for on-going inspection methodology, frequency, schedule, and coverage.
- Capital Improvement Plan including:
- Estimation of remaining service life
- Cost estimates and recommended methods for the next 50+ years of:
    - Inspections
    - Maintenance
    - Rehabilitation, Improvements, and Repairs
- Summarization of all findings and conclusions based on inspections

In addition to the Final Report, AECOM will provide all data collected in GIS format incorporated into the City's existing schema with additional fields for assessment information.

Task 6 – Distribution System PCCP Analysis

We understand that within the SPRWS water transmission system there is a multitude of varying size and age PCCP segments totaling approximately 48.57 miles in length. Internal diameters for these PCCP segments range from 16-inches to 90-inches. These PCCP segments typically convey raw water or potable water. Though there have been no major failures of this pipe to date, SPRWS desires to proactively evaluate risk and mitigate potential failures to the extent possible.

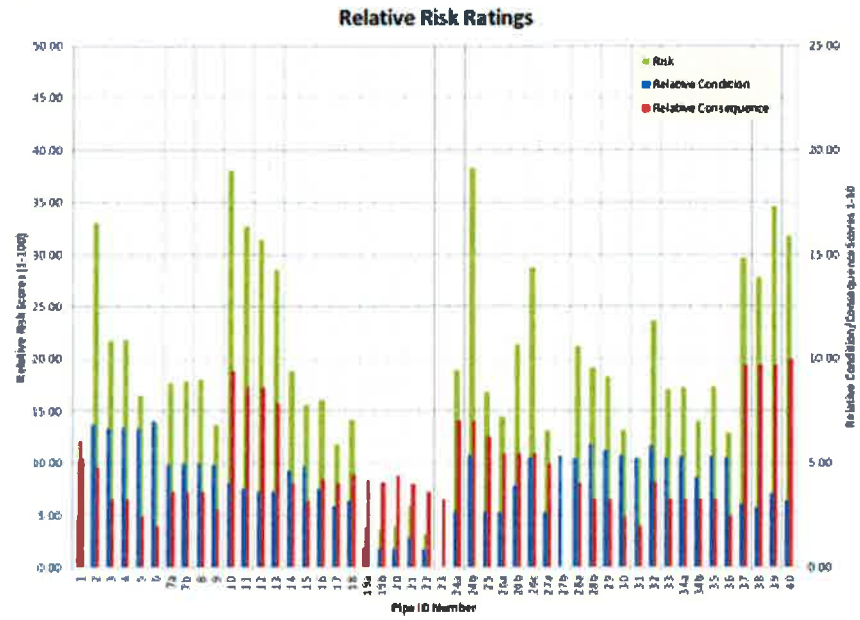
The cost of physically examining all of the existing pipe segments is prohibitively expensive, on the order of millions of dollars and the priority, timing, and investigative approach for such a program cannot be reasonably be determined without initially screening the inventory for risk factors. It is necessary to create a logical framework within which physical evaluation of high risk PCCP segments can be prioritized, have the appropriate investigative technique rationalized, and then budgeted for to facilitate implementation. The logical framework comprising this proposal is a risk based approach to initially assess both the probability of failure versus the consequence of failure for each pipe segment. Risk in this context, is the product of probability of failure times failure consequence in a traditional risk matrix. This comparative information will be used to identify and prioritize pipe segments for subsequent physical evaluation.

AECOM will perform a desktop analysis of SPRWS's existing PCCP segments. The desktop analysis will include an assessment of both the probability of failure and the consequence of failure for each pipe segment. The probability of failure portion of the desktop analysis will be formatted and performed in a manner consistent with the "Long-Form Assessment Matrix" methodology described in *Failure of Prestressed Concrete Cylinder Pipe* (Romer *et al* - Awwa Research Foundation, 2008). The desktop analysis will incorporate data about existing PCCP pipe segments provided by SPRWS. The data will be supplemented with soils information from the US Geological database to assist in characterizing external environmental exposure risk.

To the extent data is furnished by SPRWS, the desktop analysis of each PCCP segment will be based on the 38 failure probability factors described in the above-referenced Awwa document. In general these 38 factors can be grouped as follows:

- Design related factors (3 factors)
- Manufacturing related factors (10 factors)
- Inspection related factors (6 factors)
- Construction related factors (8 factors)
- Operation and Maintenance related factors (4 factors)
- Pipeline Condition indicating factors (7 factors)

Figure 7: Relative Risk Ratings Bar Chart

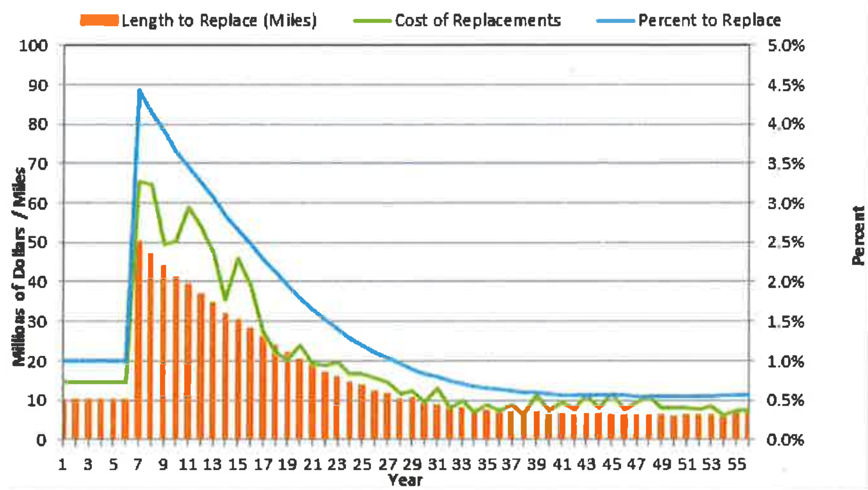


Statistical analysis of the compiled data will be performed to generate the probability of failure results for each pipe segment.

Through discussions with SPRWS a simplified consequence of failure score will be developed for each PCCP segments. The consequence of failure will consider the extent of loss of service criteria and cost of repair criteria.

The probability of failure results derived from analysis of PCCP data will be utilized in conjunction with the consequence of failure score to quantify risk for each PCCP segment. Segments with the highest risk (e.g. those that score high in both probability of failure and consequence of failure) will be recommended for subsequent investigation. Based on the nature of factors that drive the high risk factors, a specific direction for subsequent investigations will be recommended. Subsequent investigations will vary dependent on the risk drivers from physical investigations at varying levels of technological sophistication to operationally driven investigations in an attempt to better quantify risk. Figure 7 shows relative risk ratings for a very similar project AECOM completed for Tampa Bay Water.

Similar to the work completed for the SPRWS Water Main Prioritization project, AECOM will assign each pipe a Priority Action Number (PAN) which will quantify the pipe's risk exposure. From the PAN scores, AECOM will prioritize SPRWS's PCCP assets and provide models of rehabilitation plans to match SPRWS's budget and capital improvement plans.

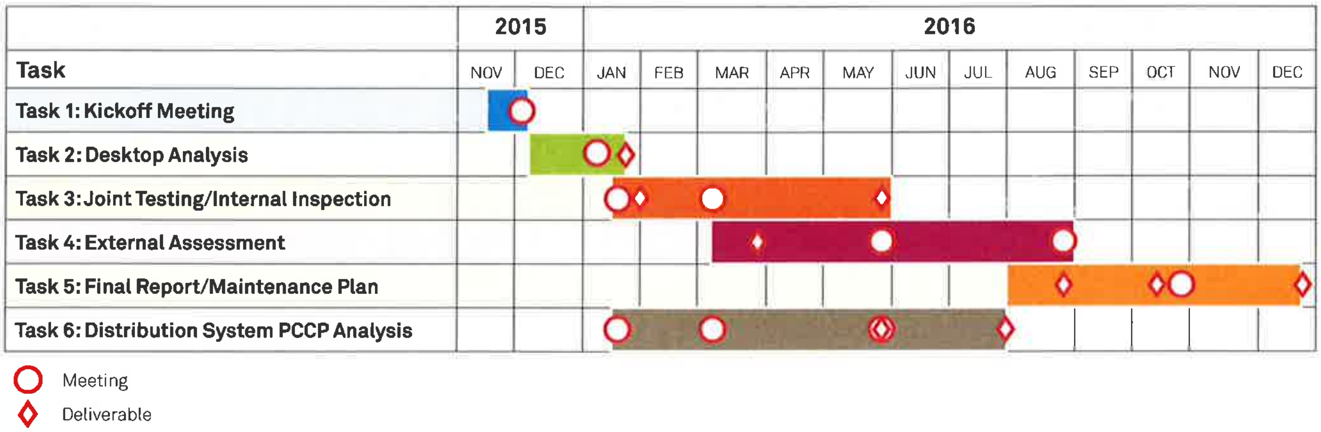


AECOM will develop a technical memorandum for this task including cost estimates for internal and external condition assessment of the PCCP system and an assessment plan.

Based on the desktop assessment, AECOM will make recommendations for the most cost effective assessment technologies and include these recommendations in the assessment plan.

Schedule

AECOM's team is committed to the below schedule and key team members will be available to complete this project as proposed.



Meeting 1:	Kickoff – Dec. 7, 2015
Meeting 2:	Discuss draft risk categorization of conduits – Jan. 5, 2016
Meeting 3:	Discuss risk categorization and field plan for joint testing/internal inspections – Jan. 18, 2016
Meeting 4:	Kickoff Task 6 – Jan. 18, 2016
Meeting 5:	Discuss progress of joint testing/ internal inspections – March 9, 2016
Meeting 6:	Discuss Task 6 risk and consequence model development – March 9, 2016
Meeting 7:	Discuss progress of external assessment and results from internal inspections – May 25, 2016
Meeting 8:	Discuss Task 6 PCCP prioritization – May 25, 2016
Meeting 9:	Discuss results from external assessment – Aug. 26, 2016
Meeting 10:	Discuss comments on Draft Condition Assessment Report – Oct. 26, 2016

Deliverable 1:	Graphical illustration of each conduit and risk categorization. – Due Jan. 22, 2016
Deliverable 2:	Field and safety plan for joint testing/internal inspections – Due Jan. 29, 2016
Deliverable 3:	Field and safety plan for external assessment – Due March 25, 2016
Deliverable 4:	Identification and location of defects from internal inspections associated with risk and consequence – Due May 25, 2016
Deliverable 5:	Draft Task 6 risk and consequence model development and Technical Memorandum – Due May 25, 2016
Deliverable 6:	Final Task 6 Technical Memorandum – Due July 27, 2016
Deliverable 7:	Final external assessment Technical Memorandum summarizing results – Due Aug. 26, 2016
Deliverable 8:	Draft Condition Assessment Report – Due Oct. 12, 2016
Deliverable 9:	Final Condition Assessment Report – Due Dec. 21, 2016

5 Proposal Cost

AECOM has developed the below fee estimate based on assumptions of average level of service encountered. The proposed fees include labor and reimbursable costs.

TOTAL PRICE SUMMARY			
Task	**Labor**	**Reimbursable Expenses**	**Total Price**
Task 1: Kick-off Meeting and Data Collection	$ 24,785	$ 1,400	$ 26,185
Task 2: Desktop Analysis	$ 29,830	$ 1,000	$ 30,830
Task 3: Joint Testing/Internal Inspection	$ 73,180	$ 93,000	$ 166,180
Task 4: External Assessment	$ 39,340	$ 20,900	$ 60,240
Task 5: Final Report/Maintenance Plan	$ 61,440	$ 1,750	$ 63,190
Task 6: Distribution System PCCP Analysis	$ 21,700	$ 1,000	$ 22,700
Total	**$ 250,275**	**$ 119,050**	**$ 369,325**

AECOM's total cost not to exceed amount is **$369,325**.

The proposed 2016 hourly rates are provided in the table below. AECOM commits to using these rates through the end of 2016.

HOURLY RATES SUMMARY	
Name and Project Role	**Billing Rate/Hour**
Tom Degen, PE, Project Manager	$ 185
Chris Macey, PE, Project Engineer	$ 265
Kevin Muellerleile, PE, Depurty Project Manager	$ 135
Marvin McDonald, CET, Condition Assessment	$ 170
Marshall Gibbons, CET, Materials Specialist	$ 135
Andrew Romer, PE, PCCP Analysis	$ 240
Kathy Beduhn, PE, Risk and Consequence Model Development	$ 140
Paul Herubin, PE, Field Inspections	$ 125
Terry Refai, PhD, Structural Specialist	$ 195
Jeremy Thomas, PE, Geotechnical Specialist	$ 130
Mike Winegard, PE, Capital Improvement Planning	$ 280
Bob Butterworth, PE, Capital Improvement Planning	$ 275
Junior Engineer	$ 90
Field Technician	$ 85
Administrative Assistant	$ 75